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Environmental Quality Index as the Foundation for Management of Aquaculture Areas in Tambak Lorok, Tanjung Mas Village, North Semarang

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Abstract
The Aquaculture Area in Tambak Lorok is one of the areas that is affected by human and industrial activities because utilizing water from the Kali Banger that has been affected by human activities, industry, etc., will reduce the water quality of the pond. The purpose of this study is to examine the water quality and saprobic index to see the level of pollution in the pond area; reviewing community perceptions for pond area management indicators; compile a community and ecosystem management strategy. The results of the study obtained that the aquaculture area in Tambak Lorok is at a level of heavy pollution, this is seen from the quality parameters that do not meet the quality standards and the saprobic index that many encounter with α-Meso-saprobic organisms. Based on the results of the SWOT analysis, the area can still be managed by increasing public awareness with the help of counseling from the government about the importance of maintaining the quality of the aquatic environment.
Keywords: Saprobic Index, Water Quality Index, SWOT Analysis

1. Introduction

The coastal area itself is a transitional area between land and sea. The coastal area is a complex area because the condition of the coastal area which is widely used for various activities that exist outside and inside the coastal area is one of the aquaculture areas (Prista, et al, 2008).

Pond is an artificial habitat that is used as a place of cultivation located in coastal areas and utilizing water sourced from river mouths. Farming activities carried out continuously can cause environmental degradation which is characterized by a decrease in water quality. Constraints faced in the cultivation of ponds include the arrangement of the area or arrangement of the cultivation space does not pay attention to the carrying capacity of the environment. As a result of improper management, it causes environmental problems in certain aspects (Mustofa, 2008).

The condition of the pond in Tambak Lorok, North Semarang, which is adjacent to the fishing village area in Tanjung Mas village, North Semarang Subdistrict, is a farming area that has unique problems related to the geological conditions of its environment. Some of these problems include a decline in the quality of the environment that has ecological risk to the survival of organisms such as those related to polluted water conditions due to sea water intrusion, groundwater exploitation, and also the worse land subsidence which all affect the condition of existing ponds in Tambak Lorok Semarang North.

Based on the background and formulation of the problem as above, the authors can conclude the objectives of the study in the form of assessing water quality and the level of water saprobitas in the Tambak Lorok area of Tanjung Mas Village, North Semarang by looking at the parameters of physics, chemistry and biology. Assessing community perceptions as an indicator of the management plan for the aquaculture area in Tambak Lorok. Develop community and ecosystem based strategies in the management of the Tambak Lorok aquaculture area.

2. Method

This research method uses descriptive research that is case study. What is meant by case studies is the study of studying objects at a limited time, place and amount, so as to provide situations and conditions for which the results are not valid for a long time. The location of the study will be carried out in the area of aquaculture in Tambor lorok. The time of the study will be held in May 2016. With sampling conducted in the morning and evening.

The taking location will be divided into 4 picking stations with each station will be divided into 3 sampling points. In this research, 2 samples taken in the morning will be carried out at 7:00 a.m. to 9:00 p.m. and the afternoon will be carried out at 04.00-06.00 and repetition will be carried out a month away, ie in June 2016 from the first sampling, this is done to obtain data significant. Determination of sampling points using purposive sampling method is the determination of location based on certain considerations, including the ease of reaching the location of the sampling point, and the efficiency of time. Primary data needed in this study are: Biological

parameter data covering plankton while physical and chemical parameters of water include (Temperature, pH, DO, BOD, COD, Salinity, Nitrate, Phosphate, Lead).

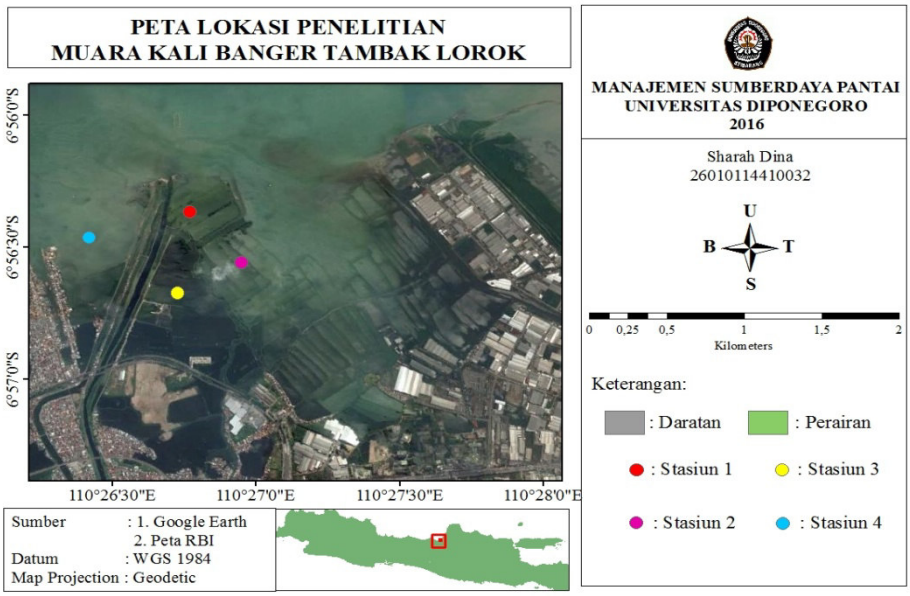

Figure 1. Location of Sampling Points

3. Result and Discussion

3.1. Effect of Environmental Parameters on Saprobitas Index

The average abundance of plankton at all stations both at sampling 1 and sampling 2 amounted to more than 12,000 ind / l. Judging from the large number of genera *Nitzschia* sp in waters due to *Nitzschia* sp is a type of phytoplankton that has a high tolerance for environmental changes, this was stated by Hogan (2008) which states that *Nitzschia* sp can survive with extreme conditions and has a high tolerance for salinity. The average abundance of plankton at all stations both at sampling 1 and sampling 2 amounted to more than 12,000 ind / l. Judging from the large number of genera *Nitzschia* sp in waters due to *Nitzschia* sp is a type of phytoplankton that has a high tolerance for environmental changes, this was stated by Hogan (2008) which states that *Nitzschia* sp can survive with extreme conditions and has a high tolerance for salinity.

According to Adji et al (2003) Nitzschia sp belongs to the class of Bacillariophyceae which is a group of algae both qualitatively and quantitatively found in various river types as plankton and periphyton. From the calculation of the Saprobitas Index value in the Tambak Lorok Aquaculture area, the results of SI obtained at sampling 1 ranged between 0.5-1 and TSI ranged from 0.3 to 1.8 while the sampling results obtained by SI ranged from 0.3 to 1, 8 and TSI range from 0.4 to 3.4. Based on the results obtained it can be concluded that the level of pollution in sampling 1 and 2 belongs to the category of α-mesosaprobic which means that the mean is in heavily polluted conditions.

Table 1. Saprobic Index (SI) and Tropik Saprobik Index (TSI) in Sampling 1 and Sampling 2

Value	Sampling 1			
	I	II	III	IV
SI	0,5	1	0,5	0,5
TSI	0,7	0,48	0,37	0,4
Value	Sampling 2			
	I	II	III	IV
SI	1	1,3	1,8	0,3
TSI	1,4	3,4	0,44	0,4

3.2. Water Quality Parameter

From the results of the study the DO content in all four stations from sampling 1 and 2 had a low yield where the DO content obtained had results below the quality standard adjusted for marine biota, this was adjusted to the statement of the Minister of Men LH 51/2004 stating that the limit optimum DO quality standard for marine biota is> 5 mg / l.

Based on the results of the study it can be said that the research location was heavily polluted. This is adjusted to Marsambuana's statement (2008) which states that if a water contains <2 mg / l, the water is declared to be heavily polluted. If the DO content is in low waters it can interfere with various activities of the organism

to live. The low DO content of the four stations in both sampling was caused by the large amount of organic and inorganic contaminant input to the aquaculture site so that the waste will experience degradation and decomposition by aerobic bacteria that need oxygen to degrade the waste so that the DO content in the water will decrease (Tarzan, 2016).

Table 2. DO content in Sampling 1 and 2

DO content at sampling 1 and 2						
	Station				Optimum Value	Bibliography
Sampling	1	2	3	4		
1	1,85	1,61	1,33	1,57	>5	Kep.Men LH 51/2004
2	0,94	0,98	0,9	0,82	>5	Kep.Men LH 51/2004

According to Napitu (2012) waters in the tropical environment have temperatures above> 250 C. This can be seen from the average temperature at the study site both at sampling 1 and sampling 2 having temperatures above> 250 C. temperature differences in an aquatic will always change all day according to the hot sun at that time. In ponds that have a depth of more than 1 meter the temperature of the water will be higher on the surface than the lower surface (Santosa and Wiharyanto, 2013). Factors influencing changes in temperature in waters are the presence of shade (eg trees or aquatic plants), wastewater (waste) entering water bodies (Chin 2006). During the rainy season the water temperature will be lower due to the absence of sunlight entering the waters so that the water temperature becomes lower (Parker, 2012).

This can be seen from the temperature gain at the research location where the average temperature obtained for sampling 1 ranged from 23.17 to 23.670C while in sampling 2 the average temperature ranged from 30.12 to 30.65 0C low temperature at sampling 1 due to the taking of the environment conditions of the pond is cloudy and rainy. The temperature of a good environment for cultivation ranges from 260C - 320C while for milkfish cultivation ranges from 240C-38.50C (Wahab, 2003).

Table 3. Amount of Temperature in Sampling 1 and 2

Temperature content at sampling 1 dan 2						
	Station				Optimun Value	Bibliography
Sampling	1	2	3	4		
1	28,08	26,32	30,28	30,5	–	–
2	30,65	30,12	30,48	30,33	–	–

Based on the results of the study, the salinity content at the study location was still at the quality standard for biota established by the Minister of Environment LH 51 of 2004 which amounted to 0.5-34 $^{0}/_{00}$. Salinity fluctuations can also be influenced by environmental factors such as heavy rain and large evaporation as well as human activities Napitu (2012). The occurrence of differences in salinity in a waters is influenced by daily weather, this was stated by Cahyono (2011) which states that weather conditions have a very large influence on changes in salinity in water. During the dry season the salinity content will increase by 60 $^{0}/_{0}$ while in the wet season it will decrease by 30 $^{0}/_{0}$. If the level of salinity in the water is too high or too low, it can cause disruption of the growth of cultivated. Based on the results of the study, the BOD content in all study locations was below the specified quality standard of 20 mg / l which was adjusted to the Minister of Environment Decree 51 of 2004. The high BOD content in both stations was due to the remaining fish feed deposits and also the two locations adjacent to the mangrove so that many get the remaining mangrove litter that falls into the pond. According to Salmin (2005) the quality criteria when viewed from the BOD content, the study location was at the moderate polluted level where the criteria of being contaminated with BOD content ranged between 10-20 mg / l.

This is adjusted from the statement from Amarashinghe and Balasubramanian (1992) mangrove litter is the largest contributor to organic matter in the waters. Mangrove litter mostly contains protein and carbohydrates which are easily broken down by decomposing microorganisms. This can also be seen from the DO content obtained from research where the DO content of the location is below the quality standard and even tends to be low. This was stated by Suparjo's statement (2009) that the degradation of organic and inorganic materials entering the waters came from the activities of the community around the river and the results of the discharge of waste disposed around the river flow without being processed in advance so as to increase BOD content in increased water. Increased levels BOD in the waters will cause a decrease in the oxygen content in the water which will affect the condition of the aquatic environment and the organisms in it.

Table 4. Salinity Content at Sampling 1 and 2

Salinity Content at Sampling 1 and 2						
	Station				Optimum Value	Bibliography
Sampling	1	2	3	4		
1	23,67	23,17	25,67	23,67	–	–
2	21	25,67	27	26,33	–	–

Table 5. BOD Content at Sampling 1 dan 2

BOD content at sampling 1 and 2						
	Station				Optimum Value	Bibliography
Sampling	1	2	3	4		
1	12,72	12,72	15,02	12,97	20	Kep.Men LH 51/2004
2	9,12	9,62	10,13	12,32	20	Kep.Men LH 51/2004

From the results of the study obtained the value of phosphate and nitrate concentrations exceeded the quality standards established where the optimum quality standard for marine biota according to the Men Minister LH 51/2004 is 0.0015 for phosphate and 0.008 for nitrate. High levels of nitrate and phosphate content can be caused by feeding on the ponds but there are inedible feeds which fall into the bottom of the waters which eventually dissolve in the waters so that it releases N and P elements where the main elements of fish feed are N and P. fish will also be degraded will produce Nitrates and Phosphates in the waters (Nugroho, et al. 2014). According to Zhu et al (2013) stated that physical and chemical factors and hydrodynamic disturbances would cause turbulence at the bottom of the water so that nutrients deposited on the bottom of the waters would be released into the water body. The release of N and P nutrients can cause a decrease in water quality so that serious treatment needs to be done (Smolder et al, 2006). Nitrates are the main form of nitrogen in natural waters and are also a major element of algal growth. Nitrate itself is not toxic to aquatic organisms. The high nitrate content in water due to the influence of human and animal feces activities. If nitrate exceeds 0.2 mg / l it can cause the growth of algae and plants to become rapid (Athiran, 2013). Nitrate content in the study location is included in the fertility category while this is adjusted to this statement adjusted to Maftuch (2015) which divides the following categories of nitrate content <0.227 mg / l infertile, 0.227-1.129 mg / l moderate fertile level, and 1.130- 11,250 mg / l high fertility.

Table 6. Content of Nitrate and Phosphate in Sampling 1 and 2

Nitrate content at sampling 1 and 2						
	Station				Optimum Value	Bibliography
Sampling	1	2	3	4		
1	0,33	0,35	0,23	0,41	0,008	Kep.Men LH 51/2004
2	1,44	0,55	1,02	1,86	0,008	Kep.Men LH 51/2004
Phosospate content at sampling 1 and 2						
	Station				Optimum Value	Bibliography
Sampling	1	2	3	4		
1	3,3	3,5	2,6	2,29	0,015	Kep.Men LH 51/2004
2	1,84	2,49	1,19	1,35	0,015	Kep.Men LH 51/2004

Lead is one of the non-essential heavy metals that are harmful to the environment. Lead is used as an additional ingredient in gasoline and combustion processes (Madusari, 2006). The lead content obtained from the results of the study has a result above the standard threshold set for marine biota based on Kep Men LH 51/2004 of 0.008 mg / l. The high lead content in ponds is caused by community and industrial activities carried to the river mouth which eventually flows into the pond area. The acquisition of lead content in the pond is obtained from the river where the river already contains polluted materials from industrial and household activities (Madusari, 2006). This was also stated by Nuhman (2003) who stated that the river flowing towards the beach would enter the pond along with the tidal conditions.

Table 7. Lead Content in sampling 1 and 2

Lead Content in sampling 1 and 2						
	Stasiun				Optimum Value	Bibliography
Sampling	1	2	3	4		
1	0,31	0,32	0,35	0,38	0,008	Kep.Men LH 51/2004
2	0,1	0,06	0,16	0,12	0,008	Kep.Men LH 51/2004

Based on the results of research on the high lead content at stations 3 and 4 at sampling 1 and 2, it was suspected that there were fishing boats that were often used for ponds that used fuel containing lead and also by the river flow used to fill ponds where the water contained at the banger river estuary will receive contamination material from the upstream which is carried into the pond pond. In addition, lead content can also come from motorized vehicles. As can be seen the environmental conditions close to the Pantura highway. According to Satya (2012) heavy metal lead can come from the remaining fuel of motorized vehicles which naturally can enter the waters due to the influence of wind and rain. Estuary areas are also always used as a place for sea transportation to be anchored. The high levels of lead in the waters, apart from disturbing organisms, can also disrupt human health, for example in milkfish aquaculture. Milkfish is a type of fish that is widely cultivated in the city of Semarang. Milkfish is a type of fish that will absorb phytoplankton, zooplanton, phytopanton and microorganisms that contain heavy metals. The lead will be bound in the body's tissues so that its concentration

will gradually increase in the body (Satya,2012) and if milkfish which contains PB consumed by humans can cause anemia, damage the nervous system, kidney and impair the reproductive system and reduce IQ (Madusari, 2016)

3.3 Water Quality Index

Based on the calculation results in the morning retrieval at sampling 1 and sampling 2 are at a high WQI level because the average WQI results obtained 00 6.00 which means that the level of water quality is in heavily polluted conditions which means that the aquaculture conditions are not suitable for use for various activities and if processing has to be done, a large fee will be needed (Altansukh and Davaa, 2011).The level of pollution obtained at stations 3 and 4 of sampling 1 and 2 has the highest level of pollution compared to other stations even though the level of pollution in other stations is at a level of heavy pollution.

Tabel 8. Water Quality Index (WQI) Sampling 1and Sampling 2

Water Quality Index Sampling 1				
Time	Stasiun			
	1	2	3	4
Morning	22,8	45	51	60
Evening	23	31	54	65
Water Quality Index Sampling 2				
Time	Stasiun			
	1	2	3	4
Morning	26	36	42,4	56
Evening	39	38	78	56

The high level of pollution is thought to be due to the location of the research where the river estuary is around the river mouth, there are many residential and industrial settlements as well as breeding of fishing boats. thus causing the aquaculture area that utilizes water from the river mouth to get high pollution levels while at stations 3 and 4 which are the locations that receive the latest water flow, get the most deposition deposits. At stations 3 and 4 there are also mangrove trees which when the litter falls into the water will cause a decomposition process that uses dissolved oxygen so that the dissolved oxygen content decreases. In addition to the lack of public awareness to maintain cleanliness of the river flow is also a cause of pollution at this location. This is adjusted from the statement of Tia et al (2013) which states that the Banger Bayak river flow area is crowded with fairly dense residential areas. The activities of the population can be the largest contributor to many organic compounds discharged into the river flow so that it will cause a decrease in water quality. The absence of adequate drainage can lead to the disposal of waste directly into the water without being treated first.

3.4 Priority Development Strategy

Based on the priority of the strategy can be divided into 7 strategies in the management of the aquaculture area in Tambak lorok Pond, Semarang City, the strategy priorities and steps of the activities can be arranged as follows:

1. Providing training and counseling on appropriate management of the pond area so as to realize structured management.
   - Conduct intensive guidance with assistance from fisheries extension workers and existing workforce.
   - Conduct routine and periodic extension activities.
2. Improving farm quality management and strengthening HR improvement
   - Maintain income from sources by avoiding direct use of water from water sources.
   - Helps improve knowledge about the management of ponds with the rocks of cultivation education institutions
3. Development of integrated cultivation areas to optimize cultivation results
   - Use land suitable for cultivation activities and build environmentally friendly aquaculture
   - Build water treatment plants before being used in ponds to avoid water quality deterioration
4. Development of a marketing system that can help the local economy
   - Perform processing of aquaculture products according to hygiene standards and quality in accordance with SNI
5. Utilizing the potential of pond results optimally and efficiently
   - Cultivate according to environmental and marketing conditions
6. Develop pond infrastructure and facilities by involving actors in the cultivation sector
   - Providing adequate facilities and infrastructure
   - Empowering institutions in terms of counseling for cultivation development
7. Establish partnerships with farm agents
   - Cooperating with other fishers by utilizing foreign organisms that enter the pond to reduce cannibalism.

Fish farming also helps increase income for fish farmers.

4. Conclusion

Based on the results of the study, the following conclusions can be drawn:

Based on the results of observations of water quality parameters and saprobic-index, it can be said that the aquaculture area in the penenlitan location is in the moderate to severe contaminated condition, this is seen from the acquisition of water quality analysis conducted by several parameters not in accordance with the temporarily determined quality standard saprobitas obtained by phytoplankton species that have a strong tolerance level for environmental changes. The community perceptions obtained in direct interviews with several farm owners they considered the results of the ponds did not have a high profit to be marketed to a higher market because the quality of the fish in the low yield so they only sold them in the market near TPI. Based on the SWOT analysis the aquaculture area in Tambak Lorok can still be managed because it still has some potential that can be developed

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